j is odd, the second projector 42 would be on. For calculations to work out properly for this alternating system, then m, the integer shift value, must be even. Thus, using this alternating approach, phase value image for the first projector 38 would be: phase value (i,2j) where j=0,1,2, . . . ; and phase value image for the second projector 42 would be: phase value (i,2j+1) where j=0,1,2, ...

If it is desirable to increase the pitch of the imaged grating pattern, a second grating 44 can be added to the imaging side as illustrated in FIG. 3. In some instances, it is desirable to include an imaging lens between the grating 44 and the array 24. The parts shown in FIG. 3 which have the same or similar function to the parts of FIG. 2 have the same reference numeral but a prime designation.

The beat effect between the two grating patterns is the optical moire effect and will increase the pitch imaged onto the detector. This can be desirable when one wants to use a pitch finer than can be resolved by the detector. That is, the primary pitch is less than the width of a pixel.

While the best mode for carrying out the invention has been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following claims.

What is claimed is:

Sub C1

1. A method for high speed, scanning phase measuring of an object at a vision station to develop physical information associated with the object, the method comprising the steps of:

projecting a pattern of imagable electromagnetic radiation with at least one projector;

moving the object relative to the at least one projector at a substantially constant velocity at the vision station so as to scan the projected pattern of electromagnetic radiation across a surface of the object to generate an imagable electromagnetic radiation signal;

receiving the imagable electromagnetic radiation signal from the surface of the object with a detector having a plurality of separate detector elements which are substantially uniformly spaced;

maintaining the at least one projector and the detector in a substantially fixed relation to each other;

measuring an amount of radiant energy in the received electromagnetic radiation signal with the detector wherein each of the detector elements produce an image having a different phase of the same scanned surface based on the measurement; and

computing phase values and amplitude values for the different phases from the multiple images.

2. The method as claimed in claim 1 wherein the physical information is dimensional information and the imagable electromagnetic radiation is light.

3. The method as claimed in claim 2 wherein the detector has an optical axis and wherein the step of moving is performed in a direction substantially parallel to the optical axis and wherein the projected pattern of light is a stripe of lines.

4. The method as claimed in claim 2 further comprising the step of determining height of the surface of the object based on the phase and amplitude values.

5. The method as claimed in claim 1 wherein the physical information is polarization information, the imagable electromagnetic radiation is polarized, a response of the detector elements is polarization sensitive and wherein the images are based on polarization from the surface.

6. The method as claimed in claim 1 wherein the plurality of detector elements are uniformly spaced and wherein the step of moving is performed uniformly and continuously.

7. The method as claimed in claim 1 wherein the step of computing includes the step of registering the images.

8. The method as claimed in claim 1 wherein the detector elements are elongated in a direction parallel to a detector axis of the detector, and wherein the detector also has an optical axis and wherein the step of moving is performed in a direction substantially perpendicular to the detector and optical axes.

9. The method as claimed in claim 8 wherein the detector is a multi-linear array camera.

10. The method as claimed in claim 8 wherein each detector element is a row of CCD sensing elements extending substantially parallel to the detector axis and wherein the step of moving is performed in a direction substantially perpendicular to the rows of the CCD sensing elements.

11. The method as claimed in claim 1 wherein the step of projecting is performed with two projectors.

12. The method as claimed in claim 11 wherein the step of moving includes the step of cycling the object relative to the two projectors wherein the two projectors alternately project the pattern of imagable electromagnetic radiation.

13. The method as claimed in claim 11 wherein the two projectors alternately project the pattern of imagable electromagnetic radiation during consecutive scans of the projected pattern of imagable electromagnetic radiation.

Sub C2

recapture

14. A system for high speed, scanning phase measuring of an object at a vision station to develop physical information associated with the object, the system including:

at least one projector for projecting a pattern of imagable electromagnetic radiation;

means for moving the object relative to the at least one projector at the vision station at a substantially constant velocity so as to scan the projected pattern of imagable electromagnetic radiation across a surface of the object to generate an imagable electromagnetic radiation signal;

a detector for receiving the imagable electromagnetic radiation signal from the surface of the object and having a plurality of separate detector elements which are substantially uniformly spaced for measuring an amount of radiant energy in the imagable electromagnetic radiation signal wherein each of the detector elements produces an image having a different phase of the same scanned surface based on the measurement;

means for maintaining the at least one projector and the detector in a substantially fixed relation to each other; and

means for computing phase values and amplitude values for the different phases from the images.

Sub A1

15. The method as claimed in claim 14 wherein the physical information is dimensional information and the imagable electromagnetic radiation is light.

16. The system as claimed in claim 15 wherein the detector has an optical component for receiving the reflected light signal, the optical component having an optical axis and wherein the means for moving moves the object relative to the at least one projector in a direction substantially parallel to the optical axis and wherein the projected pattern of light is a stripe of lines.

17. The system as claimed in claim 15 further comprising means for determining height of the surface of the object based on the phase and amplitude values.

Sub A2

18. The method as claimed in claim 14 wherein the physical information is polarization information, the imagable electromagnetic radiation is polarized, a response of the detector elements is polarization sensitive and wherein the images are based on polarization from the surface.

19. The system as claimed in claim 14 wherein the plurality of detector elements are uniformly spaced and wherein the means for moving moves the object relative to the at least one projector uniformly and continuously.

20. The system as claimed in claim 14 wherein the means for computing includes means for registering the images.

21. The system as claimed in claim 14 wherein the detector elements are elongated in a direction parallel to a detector axis of the detector and wherein the detector also has an optical component having an optical axis and wherein the means for moving moves the object relative to the at least one projector in a direction substantially perpendicular to the detector and optical axes.

22. The system as claimed in claim 21 wherein the detector is a multi-linear array camera.

23. The system as claimed in claim 21 wherein each detector element is a row of CCD sensing elements extending substantially parallel to the detector axis and wherein the means for moving moves the object relative to the detector

in a direction substantially perpendicular to the rows of the CCD sensing elements.

24. The system as claimed in claim 14 further comprising two projectors, the two projectors projecting the pattern of imagable electromagnetic radiation.

25. The system as claimed in claim 24 wherein the means for moving cycles the object relative to the two projectors wherein the two projectors alternately project the pattern of imagable electromagnetic radiation during consecutive cycles.

Sub A3

26. The system as claimed in claim 24 wherein imagable the two projectors alternately project the pattern of electromagnetic radiation during consecutive scans of the projected pattern of imagable electromagnetic radiation.

27. The system as claimed in claim 14 wherein the at least one projector and the detector at least partially define an optical head.

Add A4

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